CHARACTERISTICS OF SOME IMPORTANT COMMERCIAL WOODS

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CHARACTERISTICS OF SOME IMPORTANT COMMERCIAL WOODS

Forest Products Laboratory,[1] Forest Service
U. S. Department of Agriculture

The commercial forest land (table 1) of the United States in 1947 included about 640 million acres, of which about 10 percent was classed as old-growth saw timber. Second-growth saw timber comprised nearly 25 percent. Thus, saw-timber areas having sufficient volume for economic saw-log operations constituted slightly more than one-third of the total commercial forest area. The greater part of the remaining forest land supported immature second growth or was restocking; a small part was not restocking satisfactorily or was denuded.

The principal hardwoods may be classified in about 25 groups of individual or closely-related species and the softwoods in the same number of similar groups. In the case of the oaks and southern yellow pines, a considerable number of species are included in one group. A map showing distribution of the general forest types in the United States is shown in figure 1.

HARDWOODS

Most of the commercial hardwood species in the United States grow east of the Great Plains. The hardwoods of the West, which grow principally in Oregon and Washington, amount to only about 6-1/2 billion board feet of the 315-billion total. Hardwoods comprise about 19.5 percent of the total timber resources of the United States.

The principal localities of growth, characteristics, and uses of woods of the main commercial hardwood species or groups of species are described in the following paragraphs.

Alder, Red

The botanical range of red alder (Alnus rubra) extends along the Pacific coast northward to Alaska and southward to southern California. This species has attained commercial development along the coasts of Oregon and Washington where it has replaced some original stands of Sitka spruce, western hemlock, and Douglas-fir. Red alder is of considerable importance locally, because in these two states, it is the most abundant commercial hardwood species.

The wood of red alder has valuable intrinsic qualities that adapt it for a variety of uses. It varies from almost white to pale pinkish brown in color and has no visible boundary between heartwood and sapwood. The pores of the

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[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

wood are fairly uniform in size and distribution. Wood of red alder is moderately light in weight, averaging 28 pounds per cubic foot at 12-percent moisture content. It is intermediate in most strength properties but low in shock resistance. It has relatively low shrinkage but is not naturally durable.

The principal use of red alder is for the manufacture of furniture, but it is also used for sash, doors, and millwork.

Ash

Important species of ash are white ash (Fraxinus americana), green ash (Fraxinus pennsylvanica var. lanceolata), blue ash (Fraxinus quadrangulata), Biltmore ash (Fraxinus biltmoreana), black ash (Fraxinus nigra), pumpkin ash (Fraxinus tomentosa), and Oregon ash (Fraxinus oregona). The first six of the above species grow in the eastern half of the United States. Oregon ash grows along the Pacific coast.

Commercial white ash is a group of species that consists mostly of white ash and green ash. Biltmore ash and blue ash are included in this group but are of rather limited distribution, occurring commercially only in some areas tributary to the central Mississippi Valley. White ash is relatively more abundant than green ash in the central and northern upland areas; green ash occurs more commonly along river courses and in the southern lowlands. Black ash is important commercially in the Lake States.

In 1947, states with the greatest production of ash without reference to species were Louisiana, Pennsylvania, Wisconsin, Michigan, Ohio, and Tennessee in descending order of quantity.[2] All states east of the Great Plains produced some ash lumber.

Heartwood of commercial white ash is brown; the sapwood is light colored or nearly white. Second-growth trees have a large proportion of sapwood. Old-growth trees with a small proportion of sapwood are scarce. Heartwood of black ash from trees growing in northern swamps is mostly dark colored; wood of such trees is narrow-ringed.

Second-growth commercial white ash is particularly sought because of the inherent qualities of this wood; it is heavy, averaging 42 pounds per cubic foot at 12-percent moisture content, strong, hard and stiff, and has high resistance to shock. Because of these qualities, such "tough ash" is used principally for handles, oars, vehicle parts, and sporting and athletic goods. There is little old-growth commercial white ash now available. Tough second-growth upland ash is recognized by relatively wide growth rings and by its weight when air dry. Some handle specifications call for not less than 5 or more than 17 growth rings per inch for handles of the best grade. The addition of a weight requirement of 43 or more pounds per cubic foot at 12-percent moisture content will assure excellent material.

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[2] Information on the 1947 production of ash and the other species in this report was obtained from "Materials Survey: Lumber, Railroad Ties, Veneer and Plywood, Poles and Piles," Forest Service, U. S. Dept. of Agric., 1950.

Black ash and pumpkin ash run considerably lighter in weight, the former averaging 34 pounds and the latter, 36 pounds per cubic foot at 12-percent moisture content, and accordingly rank below commercial white ash in strength properties. Ash trees growing in southern river bottoms, especially in areas that are frequently flooded for long periods, produce buttresses that contain relatively light and weak wood. Such wood is sometimes separated from "tough" ash when sold. Oregon ash has somewhat lower strength properties than white ash, but it is used locally for the same purposes.

Ash wood of lighter weight, sometimes called "cabinet ash", is suitable for cooperage, furniture, and shipping containers. Some ash is cut into veneer. Trees of inferior grade are used for railway ties and for fuel. Because of its general usefulness, as many as forty separate uses for ash may be named.

Aspen

"Aspen" is a generally recognized name applied to bigtooth aspen (Populus grandidentata) and to quaking aspen (Populus tremuloides). Aspen does not include balsam poplar (Populus tacamahaca) and the species of Populus that make up the group of cottonwoods. In lumber statistics of the U. S. Bureau of the Census, however, the term "cottonwood" includes all of the above species. Also, the lumber of aspens and cottonwood may be mixed in trade and sold either as poplar or cottonwood. The common term "popple" is sometimes applied to the aspens. The names "popple" or "poplar" should not be confused with yellow-poplar (Liriodendron tulipifera), also known in trade as "poplar."

Production of aspen lumber can be estimated only on the basis of the cut reported for cottonwood from areas where aspen predominates. Aspens grow commercially throughout the Northeastern States and the Lake States, and locally in the states west of the Great Plains, except in the Southwest. Aspen lumber is produced principally in the Northeastern and Lake States. There is some production of aspen lumber in the Rocky Mountain States.

Heartwood of aspen is grayish white to light grayish brown. Sapwood is lighter colored and generally merges gradually into heartwood without being clearly marked. Growth rings are rather inconspicuous. Aspen wood is usually straight-grained with fine, uniform texture. It is easily worked, except for areas of tension wood that do not machine smoothly. These areas are evident in planed lumber by fuzzy surfaces. Although aspen has a rather strong characteristic odor when green or moist, well-seasoned aspen lumber does not impart odor or flavor to foodstuffs.

The wood of aspen is light in weight. Quaking aspen and bigtooth aspen average 26 and 27 pounds per cubic foot, respectively, at 12-percent moisture content. The wood is weak, soft, moderately stiff, moderately low in resistance to shock, and has a moderately high shrinkage. Some difficulty is experienced in drying, particularly when lumber contains "wet streaks" that are likely to collapse during drying.

Aspen is used for lumber, boxes and crating, paper pulp, excelsior, matches, veneer, and miscellaneous turned articles. The use of aspen for pulpwood is increasing as other pulpwood species become scarce and higher-priced.

Basswood

American basswood (Tilia americana) is the most important of the several native basswood species; next in importance is white basswood (Tilia heterophylla). Other species occur in only very small quantities. Because of the uniformity of the wood of the different species, no attempt is made to distinguish between them in lumber form. Other common names of basswood are linden, linn, and beetree.

Basswood grows in the eastern half of the United States from the Canadian provinces southward. American basswood comprises most of the basswood lumber, nearly half of which comes from the Lake States, followed in turn by the Middle Atlantic and Central States. White basswood grows principally in the southern Appalachians. Several species of lesser importance occur in the South Atlantic and Southern States, which supply only about 10 percent of the commercial production.

The heartwood of basswood is pale yellowish brown with occasional darker streaks. Basswood has wide, creamy-white or pale-brown sapwood that merges gradually into the heartwood. Growth rings are fairly distinct in a smooth cross section. When dry, the wood is without odor or taste. It is soft and light in weight, averaging 26 pounds per cubic foot at 12-percent moisture content. It has fine, even texture, and is straight-grained and easy to work with tools. Transverse shrinkage during drying is rated as large; however, basswood stays in place well and does not warp while in use.

Basswood lumber is used mainly in the manufacture of such products as venetian blinds, sash and door frames, moulding, apiary supplies, woodenware, and boxes. Some basswood is used for veneer, cooperage, excelsior, and pulpwood. Basswood in the better grades is becoming scarce and high-priced.

Beech, American

American beech (Fagus grandifolia) is the only native species of beech in the United States. It is commonly known as beech. Because of variations in the color of the heartwood, the terms "red beech" or "red-heart beech" are applied to the darker-colored heartwood and "white beech" or "white-heart beech" to the lighter-colored heartwood.

Beech grows in the eastern third of the United States and adjacent Canadian provinces. Greatest production of beech lumber in the United States is in the regions of the Central and Middle Atlantic States, which together accounted for about 65 percent of the beech lumber produced in 1947. The Southern States contributed over 20 percent, and lesser amounts came from Michigan and the New England States.

Wood of beech may have a pronounced variation in color from nearly white sapwood to reddish-brown heartwood in some trees. In other trees, heartwood is less highly colored, and there is no clear line of demarcation between heartwood and sapwood. Sapwood may be 3 to 5 inches in thickness. Growth rings are usually distinct but not conspicuous. The wood has little figure and is of close, uniform texture. It has no characteristic taste or odor.

The wood of beech is classed as heavy, weighing 45 pounds per cubic foot at 12-percent moisture content. It is hard, strong, high in resistance to shock, and highly adaptable for steam bending. Beech has large shrinkage and may warp considerably unless care is exercised during drying. Beech is not durable. It machines smoothly, wears well, and is rather easily treated with preservatives.

Largest amounts of beech go into flooring, furniture, handles, veneer, woodenware, containers, cooperage, and laundry appliances. When treated, it is suitable for railway ties. Along with other hardwoods, it is being used in the manufacture of paper pulp. Considerable quantities of beech are used for fuel, and it has been used extensively in wood distillation for the production of charcoal, acetic acid, methanol, and other products.

Birch

The important species of birch are yellow birch (Betula lutea), sweet birch (Betula lenta), and paper birch (Betula papyrifera). Other birches of some commercial importance are river birch (Betula nigra), gray birch (Betula populifolia), and western paper birch (Betula papyrifera var. occidentalis).

Yellow birch, sweet birch, and paper birch grow principally in the Northeastern States and the Lake States. Yellow and sweet birches grow along the Appalachian Mountains to northern Georgia. Yellow birch and sweet birch are the sources of most birch lumber and veneer. In 1947, production of birch lumber was highest in the Lake States, followed by the New England and Middle Atlantic States. These three regions provided more than 90 percent of the birch cut that year.

Yellow birch has white sapwood and light reddish-brown heartwood. Sweet birch has light-colored sapwood and dark-brown heartwood tinged with red. Yellow birch averages 43 pounds; sweet birch, 46 pounds; and paper birch, 38 pounds per cubic foot at 12-percent moisture content. Wood of yellow birch and sweet birch is heavy, hard, strong, and has good shock-resisting ability. It is low in natural resistance to decay. The wood is fine and uniform in texture and is capable of taking a beautiful natural finish. Paper birch, as indicated by its lower weight, is softer and lower in strength than yellow and sweet birch. None of the birches are durable in exposed or moist situations. They shrink considerably during drying, and care must be exercised to prevent checking and warping.

The higher-grade birch logs are used for veneer and lumber. Lower grades supply crossties and wood for distillation, fuel, and paper pulp. Yellow and sweet birch lumber and veneer go principally into the manufacture of furniture, boxes, baskets, crates, woodenware, cooperage, interior finish, and doors. Birch veneer goes into plywood used in airplane construction.

Paper birch, especially in the northeast, is used for turned products, including spools, bobbins, and toys. Oil of birch, which is distilled from bark and twigs of sweet birch, is used as a flavoring.

Butternut

Butternut (Juglans cinerea) is a small- to medium-sized tree of the same genus as black walnut. It is frequently called white walnut. It grows naturally in the United States from New England through New York and from the southern part of the Lake States into South Dakota and southward into northern Arkansas, Alabama, and South Carolina. The most abundant supply of the butternut is probably in the Central States, the Lake States, and the Middle Atlantic States.

The heartwood of butternut is light chestnut brown, occasionally with a reddish tinge that becomes darker with exposure. The sapwood is white and rarely over 1 inch in width. Butternut is light in weight, averaging 27 pounds per cubic foot at 12-percent moisture content. It lacks stiffness and is moderately weak in bending and in endwise compression, moderately soft, and moderately high in shock resistance. It is generally straight-grained and is easy to work with tools. The wood resembles black walnut in texture but is lighter in color. It has moderately small shrinkage.

Butternut is used principally for furniture and to a small extent for boxes, crating, general millwork, and patterns. The fruits have a rich, distinctive flavor and are used by candy manufacturers.

Cherry, Black

Black cherry (Prunus serotina) is sometimes known as cherry, wild black cherry, wild cherry, or choke cherry. It is the only native species of the genus Prunus of commercial importance for lumber production. It occurs scatteringly from southeastern Canada throughout the eastern half of the United States. In 1947 however, three-fourths of the lumber production of this species came from the Middle Atlantic States with Pennsylvania far in the lead.

The heartwood of black cherry varies in color from light to dark reddish brown and has a distinctive luster. Sapwood is narrow in old trees and nearly white. The wood has a fairly uniform texture and very satisfactory machining properties. It is moderately heavy, averaging 35 pounds per cubic foot. It is strong, stiff, moderately hard, and has high shock-resisting ability and moderately large shrinkage. It stays in place well after seasoning and has the reputation of being comparatively free from checking or warping.

Black cherry is used principally for furniture and for backing blocks on which electrotype plates are mounted. Other uses include burial caskets, woodenware novelties, patterns, and paneling in buildings and railway coaches. It has occasionally been used for gunstocks and has proved satisfactory for this purpose.

Chestnut, American

American chestnut (Castanea dentata) is known also as chestnut and sweet chestnut.

Before American chestnut was attacked by a blight, it grew in commercial quantities from the New England States southward along the Appalachian mountains to northern Georgia. Practically all standing chestnut throughout its range has been killed by blight, and future supplies must come from dead timber. There are considerable quantities of standing dead chestnut in the mountain sections of Virginia, West Virginia, North Carolina, Kentucky, Tennessee, and northern Georgia.

The heartwood of chestnut is grayish brown or brown and becomes darker with age. Sapwood is very narrow and almost white. The wood is coarse in texture, and the growth rings are made conspicuous by several rows of large, distinct pores at the beginning of each year's growth. Chestnut wood is moderately light in weight, averaging 30 pounds per cubic foot at 12-percent moisture content. It is moderately hard, moderately weak, moderately low in resistance to shock, and lacks stiffness. It seasons with little tendency to check or honeycomb and is easy to work with tools. It is one of the most durable native woods. This characteristic has made possible the utilization of dead trees a long time after they were killed by the blight.

Chestnut is used for poles, railway ties, pulpwood, and as a source of tannin. After tannin has been extracted, the spent chips are used in the manufacture of fiberboard. Chestnut lumber is used in the manufacture of furniture, caskets, boxes, and crates. It is also suitable as core stock for veneer panels.

Cottonwood

Cottonwood is a name applied to several species of the genus Populus. Most important are eastern cottonwood (Populus deltoides and varieties), also known as Carolina poplar and whitewood; swamp cottonwood (Populus heterophylla), also known as cottonwood, river cottonwood, and swamp poplar; and black cottonwood (Populus trichocarpa and variety hastata), also known as cottonwood and balm cottonwood.

Eastern cottonwood and swamp cottonwood grow throughout the eastern half of the United States. The greatest production of cottonwood lumber is estimated to be in Southern and Central States, where cottonwood grows primarily in moist soil along stream courses. Black cottonwood grows in the West Coast States and in western Montana, northern Idaho, and western Nevada. It inhabits lower elevations along river bottoms and sand bars.

The heartwood of the three cottonwoods, eastern, black, and swamp, is grayish white to light brown. Sapwood is whitish in color and may be wide or narrow. It is not clearly defined and merges gradually with the heartwood. Growth rings are inconspicuous but can be distinguished on smooth surfaces. The wood is comparatively uniform in texture and generally straight-grained. It has a characteristic sour odor when moist but is odorless when well seasoned.

The eastern cottonwood averages 28 pounds and black cottonwood, 24 pounds per cubic foot at 12-percent moisture content. Eastern cottonwood is moderately weak in bending and compression, moderately limber, moderately soft, and moderately low in ability to resist shock. Black cottonwood is slightly below eastern cottonwood in most of its strength properties. Tests of the strength properties of swamp cottonwood have not been made, but it is expected that this species would be quite similar to eastern cottonwood. Both eastern and black cottonwood have moderately large shrinkage. Some cottonwood gives difficulty in working with tools because of fuzzy surfaces. It is thought that tension wood is largely responsible for this characteristic.

Principal uses of cottonwood are for lumber, veneer, pulpwood, excelsior, and fuel. The lumber and veneer go largely into boxes, crates, and baskets. Cottonwood pulpwood is used in the manufacture of high-grade book paper. The light-colored, fairly straight grain of cottonwood makes it well suited for excelsior.

Cucumbertree

Cucumbertree (Magnolia acuminata) is known also as cucumber magnolia and mountain magnolia. Its range extends from southern New York and Ontario southward to northern Georgia and southern Missouri. Within these limits, it occurs scatteringly with other hardwoods, principally white ash, oaks, black tupelo, and yellow-poplar.

The sapwood is nearly white, and the heartwood is brownish yellow. Cucumbertree wood is close-grained and rather similar in texture to yellow-poplar. It is moderately heavy, averaging 33 pounds per cubic foot at 12-percent moisture content. It is also moderately strong, moderately hard, and shrinks only a little more than yellow-poplar.

Since cucumbertree does not occur in pure stands, lumber from it is likely to be included with yellow-poplar or in the southern part of its range with other magnolias. Products from the cucumbertree are mostly lumber with small amounts of veneer and some pulpwood. The wood is suitable for many of the same uses as yellow-poplar, including boxes, baskets, crating, furniture, millwork, and venetian blinds.

Elm

There are six species of elm in the United States: American elm (Ulmus americana), slippery elm (Ulmus fulva), rock elm (Ulmus thomasii), winged elm (Ulmus alata), cedar elm (Ulmus crassifolia), and September elm

(Ulmus serotina). American elm is also known as white elm, water elm, and gray elm; slippery elm as red elm; rock elm as cork elm or hickory elm; winged elm as Wahoo; cedar elm as red elm or basket elm; and September elm as red elm.

American elm grows throughout the eastern half of the United States, except in higher elevations of the Appalachian Mountains. Slippery elm occupies about the same area, excepting the Atlantic Coastal Plain, most of Florida, and along the Gulf coast. Rock elm occurs from New Hampshire southward as far as northern Tennessee and westward into Nebraska. It extends northward through Iowa, southern Wisconsin, and the lower half of the southern peninsula of Michigan. Winged elm grows from the Ohio Valley southward to the Gulf, except in southern Florida. It extends westward to eastern Texas. Cedar elm occupies a rather limited area from southern Arkansas and eastern Mississippi into eastern and southeastern Texas. Slippery elm is reported as being most abundant in the central Mississippi Valley.

The sapwood of the elms is nearly white and generally quite thick, except in slippery elm where it rarely exceeds one-half inch in thickness. Heartwood of elm is light brown, often tinged with red. The elms may be divided into two general classes, hard elms and soft elms, based on the weight and strength of the wood. Hard elm includes rock elm, winged elm, cedar elm, and September elm. American elm and slippery elm are the soft elms. American elm and slippery elm are moderately heavy, averaging 35 and 37 pounds per cubic foot, respectively, at 12-percent moisture content. They have a high degree of shock-resisting ability and are moderately hard and stiff. Rock elm is somewhat heavier than American elm and averages 44 pounds per cubic foot. Specific gravity tests of winged elm and cedar elm show them to be about equal to rock elm in weight. No data are available for September elm. American, slippery, and rock elm are only moderately resistant to decay. The elms require care in drying because of their tendency to warp and twist. All of these three species have excellent bending qualities.

Total production of elm lumber in 1947[2] was rather equally divided among the Lake States, the Central States, and the Southern States. Only 5 percent of the cut came from the Middle Atlantic States.

Elm lumber is used principally in the manufacture of containers, such as boxes, baskets, crates, and slack barrels; furniture; agricultural supplies and implements; caskets and burial boxes; and vehicles. For many uses, the different species are employed indiscriminately. For others, the hard elms are preferred. Elm is used to a great extent for crating heavy articles. In the furniture industry, it is especially adapted for bent parts of chairs. Elm veneer is used for fruit, vegetable, and cheese boxes, and for baskets.

Hackberry

Hackberry (Celtis occidentalis) and sugarberry (Celtis laevigata) supply the lumber known in the trade as hackberry. Hackberry grows in the United States east of the Great Plains from Alabama, Georgia, Arkansas, and Oklahoma northward, except in northern Minnesota, Wisconsin, Michigan, New York, Vermont, New Hampshire, and all of Maine. Sugarberry overlaps

the southern part of the range of hackberry and grows throughout the Southern and South Atlantic States. The wood of the two species is similar and is not separated in the trade.

The sapwood of these species is 3 inches or more in width and varies in color from pale yellow to greenish or grayish yellow. Heartwood is not distinctly defined but is commonly darker in color than sapwood. Growth rings are distinct. The wood resembles elm in structure.

Wood of hackberry is moderately heavy, the northern species averaging 37 pounds and sugarberry, 36 pounds per cubic foot at 12-percent moisture content. It is moderately strong in bending, moderately weak in compression parallel to the grain, moderately hard to hard, high in shock resistance, but low in stiffness. It has moderately large to large shrinkage but keeps its shape well during seasoning.

Hackberry lumber comes principally from Mississippi, Louisiana, Arkansas, Oklahoma, and Alabama, indicating that sugarberry predominates in the lumber on the market. Most hackberry is cut into lumber with small amounts going into dimension stock and some into veneer. It is used principally for furniture and to a lesser extent for boxes, baskets, and other containers.

Hickory, Pecan

Species of the pecan group include bitternut hickory (Carya cordiformis), pecan (Carya illinoensis), water hickory (Carya aquatica), and nutmeg hickory (Carya myristicaeformis). Bitternut hickory grows throughout the eastern half of the United States. The other three species are confined largely to the Southern States. Pecan hickory grows from central Texas northward through Louisiana, Oklahoma, and Arkansas into Missouri and along the Mississippi Valley to Illinois and Indiana. Water hickory grows in the lower South from Texas to South Carolina. Nutmeg hickory occurs principally in Texas, northern Louisiana, and in scattered areas in other Southern States.

The wood of the pecan hickories is rather similar in appearance to that of the true hickories. They have white or nearly white sapwood, which is relatively wide, and somewhat darker heartwood. Like the true hickories, they are typically ring porous. The wood is heavy to very heavy and sometimes has very large shrinkage. The weights of the species are:Bitternut and pecan, 46 pounds; water hickory, 43 pounds; and nutmeg hickory, 42 pounds per cubic foot at 12-percent moisture content. The weight of the wood is an indication of its relative strength properties.

The heavy pecan hickories overlap the lowest true hickory in weight and in many strength properties, and therefore, they can be used for the same purposes as the true hickories for less exacting requirements. They find use in tool and implement handles and for other special products. Some pecan hickory is giving satisfactory use as flooring. The poorer grades are recommended for use in pallets.

Hickory, True

True hickories are found throughout most of the eastern half of the United States. The species most important commercially are shagbark (Carya ovata), pignut (Carya glabra), shellbark (Carya laciniosa), mockernut (Carya tomentosa), and red hickory (Carya ovalis). There are several other species of true hickories of more limited distribution. Each of the true hickories is known by several other common names.

The greatest commercial production of the true hickories is in the Middle Atlantic and Central States. The Southern and South Atlantic States produce nearly half of all hickory lumber, but since figures on production of lumber from pecan hickories and from true hickories are combined in census reports, the relative proportion of true hickory and pecan hickory from the South is unknown.

Sapwood of hickory is white and usually quite thick, except in old, slowly growing trees. It frequently is specified for certain items such as handles. Heartwood of hickory is reddish in color and is less desirable than white sapwood for certain uses. From the standpoint of strength, however, no distinction should be made between sapwood and heartwood having the same weight.

The wood of the true hickories is very tough, heavy, hard, and strong; this combination of high strength, stiffness, hardness, and shock resistance has not been found in any other native commercial wood. Hickory is low in natural resistance to decay and shrinks considerably in drying. Because of its hardness, hickory does not nail easily when thoroughly dry. For hickory of high strength, some specifications limit the number of growth rings to not more than 17 per inch for the best grades. Other specifications may include weights per cubic foot. For example, one specification for hickory handles calls for the highest grade to weigh 55 pounds or more per cubic foot at 12-percent moisture content and to have not more than 17 annual rings per inch. The second grade requires wood of 48 to 55 pounds per cubic foot and not more than 22 rings per inch. Average weights per cubic foot at 12-percent moisture content are: shagbark, 50 pounds; shellbark, 48 pounds; pignut, 52 pounds; and mockernut, 51 pounds.

Occasionally, fast-growing hickory from the butt of second-growth trees lacks stiffness and is known in the trade as rubber hickory. Such hickory can be identified by the dull tone produced when blanks of rather small dimensions are dropped endwise on a hard surface, such as a concrete floor; stiff hickory gives a clear ringing tone under this test.

The true hickories provide material for many items in which shock resistance is important, about three-fourths of the hickory production being used in the tool-handle industry for axe, pick, sledge, and hammer handles. It is used in the manufacture of ladder rungs, sporting and athletic goods, agricultural implements, dowling, gymnasium apparatus, poles, shafts, sucker rods of various sizes and dimensions, lawn furniture, and well pumps.

Because of its high density, hickory is one of the best fuel woods. It is also favored for use in smoking meats. There is a considerable quantity of lower-grade hickory that, because of knottiness or other defects and low density, is not suitable for the special uses of high-quality hickory. Markets are being sought for such material, which seems to be particularly useful for such items as pallets, blocking, and similar uses where rough and defective lumber can be utilized.

Locust, Black

Black locust (Robinia pseudoacacia) may sometimes be called yellow locust, white locust, green locust, or post locust. Its natural distribution in the United States is from Pennsylvania along the Appalachian Mountains to northern Georgia. It is also native to a small area in northwestern Arkansas. It has been extensively planted throughout the United States and is now found in practically every state. The greatest production of black locust timber is in Tennessee, Kentucky, West Virginia, and Virginia.

Wood of the genus Gleditsia may be confused with black locust because of the similarity of names of certain species in this genus, such as water locust (Gleditsia aquatica) and Texas honeylocust (Gleditsia texana). These species are of little commercial importance.

Black locust has narrow, creamy-white sapwood. The heartwood, when freshly cut, varies in color from greenish yellow to dark brown. Black locust is very heavy, averaging 48 pounds per cubic foot at 12-percent moisture content. The wood is very hard, very high in resistance to shock, and ranks very high in strength and stiffness. It has moderately small shrinkage. The high degree of durability of the heartwood is one of the outstanding characteristics of black locust.

Black locust is used extensively for round, hewed, or split mine timbers, and for fence posts, poles, railroad ties, stakes, and fuel. An important product manufactured from black locust is insulator pins, a use for which the wood is well adapted because of its strength, durability, and moderate shrinkage and swelling. Other uses are for rough construction, crating, tree-nails, and mine equipment.

Maple

Commercial species of maple in the United States include sugar maple (Acer saccharum), black maple (Acer nigrum), silver maple (Acer saccharinum), red maple (Acer rubrum), boxelder (Acer negundo), and bigleaf maple (Acer macrophyllum). Sugar maple is also known as hard maple, rock maple, sugar tree, and black maple; black maple as hard maple, black sugar maple, and sugar maple; silver maple as white maple, river maple, water maple, and swamp maple; red maple as soft maple, water maple, scarlet maple, white maple, and swamp maple; boxelder as ash-leaved maple, three-leaved maple, and cut-leaved maple; and bigleaf maple as Oregon maple.

Sugar maple grows in the United States from Maine to Minnesota, southward along the Appalachian Mountains to northern Georgia and Alabama, westward to the Great Plains, and southward to Arkansas, northwestern Louisiana, and northeastern Texas. Black maple has a more limited range, both northward and southward, and occupies mainly a belt from New York through southern Michigan, southward to Kentucky and westward to the Missouri River in Iowa. Silver maple grows throughout the eastern half of the United States, except the narrow belt along the South Atlantic States, the Peninsula of Florida, and southern Alabama, Mississippi, Louisiana, and Texas. Red maple grows throughout the region east of the Plain States southward to the Gulf of Mexico, except for the southern tip of Florida. Boxelder grows mainly from Minnesota southward to the middle of Texas, and eastward to Pennsylvania and the Atlantic States, except for the Appalachian Mountains, and the Atlantic and Gulf Coastal Plains. Bigleaf maple grows along the Pacific coast of Washington, Oregon, and California.

Although five of the maple species have wide distribution in the eastern half of the United States, the lumber comes principally from the Middle Atlantic and Lake States, which together account for about two-thirds of the production. A considerable amount of maple is cut in New England and some in the South Atlantic and Southern States. The production figures are not given separately for the hard maples and soft maples, but it may be considered that production in the New England, Middle Atlantic, and Lake States is principally hard maple.

The wood of sugar maple and black maple is known as hard maple; that of silver maple, red maple, and boxelder as soft maple. The sapwood of the maples is commonly white with a slight reddish-brown tinge. It is usually quite wide, ranging from 3 to 5 inches or more in thickness. Heartwood is usually light reddish brown but sometimes is considerably darker. Sugar maple has a fine, uniform texture. It is heavy, averaging 44 pounds per cubic foot at 12-percent moisture content. It is strong, stiff, hard, resistant to shock, but has large shrinkage. Sugar maple is generally straight-grained, but some trees are characterized by curly, wavy, or bird's-eye grain. Black maple approaches sugar maple closely in all its properties, and lumber of the two species cannot be separately recognized. The sapwood of the soft maple is considerably wider than that of the hard maples, and the heartwood is lighter in color. Red maple is somewhat heavier than silver maple, the former averaging 38 pounds and the latter, 33 pounds per cubic foot at 12-percent moisture content. Bigleaf maple is intermediate between the soft maples and hard maples in strength properties.

Maple is used principally for lumber, veneer, crossties, distillation wood, and paper pulp. A large proportion of maple lumber is manufactured into such products as flooring, furniture, boxes and crates, shoe lasts, handles, woodenware, novelties, motor-vehicle parts, spools, and bobbins. Sugar maple is suitable for flooring because of its hardness and resistance to abrasion. It is used for bowling alleys, dance floors, and factory floors. It is used also in musical instruments, especially for piano frames. Sugar maple is the source of maple sugar.

Oak (Red oak group)

Among the numerous species of red oaks in the United States, ten have considerable commercial importance. They are:

(1) Northern red oak (Quercus borealis), also known as eastern red oak, which grows in the eastern half of the United States, except in the lower Mississippi Valley, Florida, the Atlantic Coastal Plain of Georgia, and South and North Carolina. It is the most important lumber tree of the red oak group.

(2) Scarlet oak (Quercus coccinea), which grows in the eastern third of the United States, except in the southern border states and the northernmost portions of New York, Vermont, New Hampshire, and Maine.

(3) Shumard oak (Quercus shumardii) also known as Schneck oak, Texas oak, and southern red oak, which grows chiefly along the Atlantic and Gulf coasts, and in the Mississippi Valley region.

(4) Pin oak (Quercus palustris), also known as swamp oak, which grows principally in the central Mississippi Valley, and eastward through Pennsylvania and Virginia to the Atlantic coast.

(5) Nuttall oak (Quercus nuttalli), which grows in the lower Mississippi Valley region from Missouri southward, and from Alabama to Texas.

(6) Black oak (Quercus velutina), also known as yellow oak, which grows in the eastern half of the United States from Maine to northern Florida and westward to the Great Plains.

(7) Southern red oak (Quercus falcata), which grows in southeastern United States from New Jersey to Missouri, Arkansas, and Texas.

(8) Water oak (Quercus nigra), which grows in the South Atlantic and Gulf States from Maryland to Texas.

(9) Laurel oak (Quercus laurifolia), which grows in the South Atlantic and Gulf Coastal Plains from Maryland to Louisiana.

(10) Willow oak (Quercus phellos), which grows along the Atlantic and Gulf coasts and in the lower Mississippi Valley region.

The red oaks are estimated to comprise somewhat more than one-half (55 percent) of the standing oak timber in the United States. The greatest quantities of red oak lumber come from the Southern States, the southern mountain regions, and the Atlantic Coastal Plain. These areas are estimated to contain about three-fourths of the standing oak timber, and in 1947 produced more than half of the oak timber cut. These estimates are based on the combined stand and quantity of both red and white oak groups.

Sapwood of the oaks is nearly white in color and varies from 1 to 2 inches or more in thickness. Heartwood is brown with a tinge of red. Red oaks are all ring porous and have distinct growth rings. Sawed lumber of the

various species of red oak cannot be separated on the basis of the characteristics of the wood alone. Red oak lumber can be separated from that of the white oaks, however, by the absence of the froth-like growth known as tyloses in the pores, and by the larger size of the summerwood pores. If these pores are plainly visible as minute, rounded openings and can be readily counted under a hard lens, the wood belongs to the red oak group. The open pores of the red oaks make these species unsuitable for tight cooperage. Quarter-sawed lumber of the oaks is distinguished by the broad and conspicuous rays, which add to its attractiveness.

Wood of the red oaks ranges in weight from 43 to 49 pounds per cubic foot at 12-percent moisture content, the average being about 45 pounds. This average is somewhat lower than that of the white oaks, but there is considerable overlapping in the weight range of wood of the two groups. Rapidly grown second-growth oak is generally harder and tougher than finer-grained old-growth timber. The red oaks have fairly large shrinkage in drying.

The red oaks are largely cut into lumber, crossties, mine timbers, fence posts, veneer, and fuel wood. Ties, mine timbers, and fence posts require preservative treatment for satisfactory service. Red oak lumber is remanufactured into a great many items, including flooring, furniture, general millwork, boxes and crates, agricultural implements, caskets and coffins, woodenware and handles. It is also used in construction of railroad cars and boats.

Oak (White oak group)

There are nine important species of the white oak group and all grow mainly in the eastern United States. They are:

(1) White oak (Quercus alba), which grows throughout the eastern half of the United States and adjacent Canada, except in the Florida Peninsula and the Mississippi River Delta of Louisiana. It is the most important lumber tree of the white oak group.

(2) Chestnut oak (Quercus montana), also known as rock chestnut oak or rock oak, which grows from southern Vermont and New Hampshire, southward along the Appalachian Mountains to central Georgia and Alabama.

(3) Post oak (Quercus stellata), which grows throughout the eastern half of the United States from southern New England southward, except for the Florida Peninsula, and westward to the Great Plains.

(4) Overcup oak (Quercus lyrata), also known as swamp white oak, which grows in the Atlantic Coastal States from New Jersey to northern Florida, westward to Texas, extending northward in the Mississippi Valley as far as southern Illinois and Indiana.

(5) Swamp chestnut oak (Quercus prinus), also known as basket oak and cow oak, which grows along the Atlantic coast, except the Florida Peninsula, and then westward to Texas and northward in the Mississippi Valley to southern Illinois and Indiana.

(6) Bur oak (Quercus macrocarpa), which grows mainly from New York and eastern Pennsylvania westward and southward through Ohio and Kentucky into Texas, and then northward to Montana and North Dakota, extending into southern Canada.

(7) Chinquapin oak (Quercus muehlenbergii), which grows from New York, southern Michigan, and southern Minnesota southward to the Gulf of Mexico, except for the Atlantic Coastal Plain and the Florida peninsula.

(8) Swamp white oak (Quercus bicolor), which grows from southern Maine through the New England, Middle Atlantic, and Central States to the Great Plains.

(9) Live oak (Quercus virginiana), which is limited to the Atlantic Coastal Plain, Florida, and the Gulf Coast, extending across the southern portion of Texas. It is estimated that the white oaks comprise about 45 percent of the standing oak timber in the United States. As in the case of red oak, white oak lumber comes chiefly from the South, South Atlantic, and Central States, including the southern Appalachian area.

The heartwood of the white oaks is generally grayish brown, and the sapwood, which ranges from 1 to 2 inches or more in thickness is nearly white. The pores of the heartwood of white oaks are usually plugged with a froth-like growth known as tyloses. These tend to make the wood inpenetrable to liquids, and for this reason most species of the white oak group are suitable for the manufacture of tight cooperage. Chestnut oak is an exception because of the absence of tyloses in many of the pores.

To tell for a certainty whether a piece of oak belongs to the white or red oak group, cut the end grain smoothly with a sharp knife across several growth rings of average width. With a hand lens examine the small pores in the dense summerwood. If the pores in the summerwood are very small, somewhat angular, and so numerous that it would be exceedingly difficult to count them, the wood belongs to the white oak group.

The wood of white oak averages somewhat heavier than that of the red oaks, ranging from 45 to 50 pounds per cubic foot at 12-percent moisture content, and averaging 47 pounds when live oak is excluded. Live oak is much heavier than any of the other oaks, averaging 62 pounds per cubic foot at 12-percent moisture content. The heartwood of the white oaks is considered to be somewhat more decay resistant than that of the red oaks.

White oaks are used for the production of lumber, crossties, cooperage, mine timbers, fence posts, veneer, fuel wood, and many other products. High-quality white oak is especially sought for tight cooperage. White oak lumber and red oak lumber are used for similar purposes, except for certain more critical uses for which white oak is specified because of its somewhat superior strength and durability. Live oak is considerably above the other oaks in strength properties and was formerly used extensively for ship timbers. An important use of white oak is for bent parts in ship and boat building. It is also important for use in flooring, agricultural implements, railroad-car construction and repair, furniture, sash, doors, millwork, and many other items.

Magnolia, Southern

Two species comprise commercial magnolia from the Southern States. They are southern magnolia (Magnolia grandiflora), and sweetbay (Magnolia virginiana). Other names for southern magnolia are evergreen magnolia, magnolia, big laurel, bull bay, and laurel bay. Sweetbay is sometimes called swamp magnolia, or more often, simply magnolia. The other names applied to southern magnolia are sometimes also applied to sweetbay.

The natural range of sweetbay extends along the Atlantic and Gulf coasts from Long Island to Texas, and that of southern magnolia from North Carolina to Texas. Southern magnolia does not grow at the southern end of Florida, and both sweetbay and southern magnolia are absent from the extreme southern portion of the Mississippi River Delta. Louisiana has been the leading state in the production of magnolia lumber for a number of years, followed by Florida, Mississippi, and Texas.

The sapwood of southern magnolia is yellowish white, and the heartwood is light to dark brown with a tinge of yellow or green. The wood has close, uniform texture, and is generally straight-grained. It closely resembles yellow-poplar from which it can be separated only by careful examination. Southern magnolia wood is moderately heavy. It is moderately low in shrinkage, moderately weak in bending and compression, moderately stiff, moderately hard, and moderately high in shock resistance. It is not durable when subjected to conditions favorable to decay. No data are available on the strength properties of sweetbay. It is reported to be much like southern magnolia in appearance and properties. The wood of southern magnolia at 12-percent moisture content weighs 35 pounds per cubic foot.

Magnolia lumber is used principally in the manufacture of furniture, boxes, venetian blinds, sash, doors, veneer, and millwork.

Sweetgum

Sweetgum (Liquidambar styraciflua) is frequently called red gum, star-leaved gum, or merely gum. Lumber from sweetgum is usually divided into two classes — sap gum, the light colored wood from the sapwood, and red gum, which is cut from the heartwood.

Sweetgum grows from southwestern Connecticut westward into Missouri and southward to the Gulf, except in the lower half of the Florida Peninsula. The production of red gum lumber is almost entirely from the Southern and South Atlantic States, the former being credited with about 83 percent and the latter with 13 percent of the lumber cut in 1947.

The wide sapwood of sweetgum is white, tinged with pink. The heartwood is reddish brown in varying shades. The annual rings are inconspicuous, and the wood is uniform in texture. It has interlocked grain, which makes it necessary to use care in drying, and which also produces cross grain in the lumber. The interlocked grain causes a ribbon stripe, however, which is desirable for inside finish or furniture. Sweetgum averages 34 pounds per cubic foot at 12-percent moisture content and is rated as moderately heavy and

hard. It is moderately strong, moderately stiff, and moderately high in shock resistance. Sweetgum is classed with wood of intermediate durability.

Sweetgum is used principally for lumber, veneer, plywood, and slack cooperage. Some sweetgum is used for crossties, fuel, and paper pulp. The lumber goes principally into boxes and crates, furniture, radio and phonograph cabinets, interior trim, and millwork. Sweetgum veneer and plywood are used for boxes, crates, baskets, and interior wood work.

Sycamore, American

American sycamore (Platanus occidentalis) is also known as sycamore, and sometimes as button-wood, button-ball tree, and plane-tree. Sycamore grows from Maine westward to Nebraska and southward to eastern Texas and northern Florida. It usually inhabits moist lands and the edges of streams, lakes, and swamps. In the production of sycamore lumber, the Central States ranked first with about 40 percent of the cut in 1947. The Southern States produced 33 percent and the South Atlantic States about 9 percent.

The heartwood of sycamore is reddish brown; sapwood is lighter in color and varies from 1-1/2 to 3 inches in thickness. In quarter-sawed lumber, the rays are very conspicuous and, though smaller, resemble those in quarter-sawed oak. The wood of sycamore has a fine texture and interlocked grain. It shrinks moderately in drying. Sycamore wood averages 34 pounds per cubic foot at 12-percent moisture content. It is moderately hard, moderately stiff, moderately strong, and has good resistance to shock. It requires care in seasoning to prevent warping and is not durable.

Sycamore is used principally for lumber, veneer, railway ties, cooperage, fence posts, and fuel. Sycamore lumber is used largely for furniture and for boxes, particularly small food containers. Other products include flooring, handles, and butcher's blocks. Veneer is used for fruit and vegetable baskets.

Tupelo

The tupelo group includes four species belonging to the genus Nyssa. They are water tupelo (Nyssa aquatica), also known as tupelo gum, swamp tupelo, and gum; black tupelo (Nyssa sylvatica), also known as blackgum, and sour gum; swamp tupelo (Nyssa sylvatica var. biflora), also known as swamp blackgum, blackgum, tupelo gum, and sour gum; and ogeechee tupelo (Nyssa ogeche) also known as sour tupelo, gopher plum, tupelo, and ogeechee plum.

All of the tupelos, except black tupelo, grow principally in fresh-water swamps and along the edges of streams and ponds in the southeastern United States. Black tupelo grows in the eastern United States from Maine to Texas, except the Peninsula of Florida, and westward into Illinois and Missouri. About two-thirds of the production of tupelo lumber is from the Southern States and nearly another one-third from the South Atlantic States. The Middle Atlantic and Central States are credited with about 4 percent of the total tupelo production and it is likely that the cut from these areas is largely black tupelo.

Wood of the different tupelos is quite similar in appearance and properties. Heartwood is light brownish gray and merges gradually into the lighter-colored sapwood, which is generally several inches wide. Annual rings are indistinct and frequently very difficult to count. The wood has fine uniform texture and interlocked grain which prevents splintering and makes the wood difficult to split. Tupelo wood is rated as moderately heavy. Wood of water tupelo and black tupelo at 12-percent moisture content averages 35 pounds per cubic foot in weight. It is moderately strong, moderately hard and stiff, and moderately high in shock resistance. Buttresses of trees growing in swamps or other places where the ground surface is covered with water for a considerable length of time contain wood that is much lighter in weight than that from upper portions of the same trees. For some uses, as in the case of buttressed ash trees, this wood should be separated from the heavier wood to prevent dissatisfaction in use. Because of interlocked grain, tupelo lumber requires care in drying. Quarter-sawed lumber is less likely to warp than plain-sawed lumber.

Tupelo is used principally for lumber, veneer, paper pulp, and to some extent for railway ties and cooperage. Lumber goes into boxes, crates, baskets, and furniture. Over half of the tupelo used for containers is black tupelo, and most of the tupelo used for furniture is water tupelo. The light-weight wood from buttressed trees is used as floats for fish nets.

Walnut, Black

Black walnut (Juglans nigra) is also known as American black walnut. It's natural range covers a large area extending from Vermont to the Great Plains and southward into the Piedmont Plateau, northern Louisiana, and Texas. In 1947, about three-quarters of the black walnut timber was produced in the Central States, 12 percent in the Southern States, and 8 percent in the Middle Atlantic States.

The heartwood of black walnut varies in color from light to dark brown; the sapwood is nearly white. In forest-grown trees, the sapwood is relatively narrow, while in open-grown trees it may be as much as 3 inches in width. Annual rings of growth are marked by the presence of many pores at the beginning of each season of growth. The wood sometimes contains alternate light and dark stripes that produce figured effects in boards and veneer. Wavy or curly grain near knots or other irregular growth, such as forks, burls, and stump wood, give rise to handsome figure. Black walnut is normally straight-grained, easily worked with tools, and shrinks and swells little after being seasoned. The heartwood ranks well in durability. Black walnut is heavy, averaging 39 pounds per cubic foot at 12-percent moisture content. It is hard, strong, stiff, and has good resistance to shock. Black walnut wood finishes especially well.

The outstanding use of black walnut is for furniture. Other important uses are for radio and phonograph cabinets, sewing machines, gunstocks, and interior finish. It is used either as solid wood or as plywood in which black walnut supplies the finished surfaces. Black walnut veneer is manufactured principally by the slicing method. The nuts of black walnut have long been used for food, principally in candy making and also in breads and cakes.

Willow, Black

Black willow (Salix nigra) is the most important of the many willows that grow in the United States. It is the only one to supply lumber to the market under its own name. A few other native willows grow to tree size in some places. Among them are the peachleaf willow (Salix amygdaloides), the sandbar willow (Salix interior), Pacific willow (Salix lasiandra), red willow (Salix laevigata), and arroyo willow (Salix lasiolepis). The last three named are western species. Several imported species and varieties of willow have escaped from cultivation and now grow naturally in many places. Among them are white willow (Salix alba), and crack willow (Salix fragilis). The last two or their varieties are thought to be the species principally used for artificial limbs, known in the industry as "white willow," "yellow willow," and "red willow." The botanical identification of the species to which these common names apply is not well established.

Black willow has the greatest commercial production in the Mississippi Delta from Louisiana to southern Missouri and Illinois.

Heartwood of black willow is grayish brown or light reddish brown in color, frequently containing darker streaks. Sapwood is whitish to creamy yellow. The growth rings are rather indistinct. The wood of black willow is uniform in texture with a somewhat interlocked grain that makes it resistant to splitting. The wood is light in weight, averaging 26 pounds per cubic foot at 12-percent moisture content. It is exceedingly weak when used as a beam or post, moderately soft, and moderately high in shock resistance. It has moderately large shrinkage. Black willow is not durable when used under conditions favorable to decay.

The wood of willow is cut principally into lumber. Small amounts are used for slack cooperage, veneer, excelsior, charcoal, paper pulp, artificial limbs, fuel and fence posts. Black willow lumber is remanufactured principally into boxes, baskets, crates, caskets, and furniture. Willow lumber is also suitable in some forms of building construction, such as roof and wall sheathing, subflooring, and studding.

Yellow-poplar

Yellow-poplar (Liriodendron tulipifera) is also known as tulip poplar, tulipwood, hickory poplar, and poplar. Sapwood from yellow-poplar is sometimes called white poplar or whitewood.

Yellow-poplar grows from Connecticut and New York southward to northern Florida and northeastern Louisiana, and westward to Illinois, southeastern Missouri, and eastern Arkansas. In 1947, the greatest commercial production of yellow-poplar lumber was from the South, and more than half of the production for that region was supplied by the states of Alabama and Georgia. The South Atlantic States followed in quantity produced, with Virginia leading and North Carolina second. The Central States and Middle Atlantic States also produced relatively large amounts of lumber from this species.

Sapwood of yellow-poplar is white and is frequently several inches in thickness. The heartwood is yellowish brown, sometimes with colored areas or streaks in shades of purple, green, black, blue, or red. These colorations do not affect the physical properties of the wood. The wood is generally straight-grained and comparatively uniform in texture. It is moderately light in weight, averaging 28 pounds per cubic foot at 12-percent moisture content for old-growth timber. Wood of second-growth timber may be considerably heavier. Old-growth timber is reported as being moderately weak in bending, moderately soft, and moderately low in shock resistance. It has a moderately large shrinkage when dried from a green condition, but is not difficult to season and stays in place well after seasoning is completed. The wood is not durable under conditions favorable to decay.

Much of the second-growth yellow-poplar is heavier, harder, and stronger than that from virgin-growth trees. Weights of more than 32 pounds per cubic foot at 12-percent moisture content are not uncommon. Such wood is not so suitable for uses where soft texture is desired as old-growth poplar, but it is suitable for uses where fairly high strength is desired. Selected trees of second-growth yellow-poplar produced wood heavy enough for gunstock production.

A list of products that can be made from yellow-poplar includes nearly fifty items. Large, clear, old-growth logs of yellow-poplar are well suited to the manufacture of veneer. Lumber from yellow-poplar goes mostly into furniture, interior finish, siding, radio cabinets, and musical instruments. Boxes and crates are made from lower-grade stock not suitable for more exacting uses. Yellow-poplar veneer is used extensively in the form of built-up plywood panels for finish, furniture, piano cases, and various other uses. Yellow-poplar is used also for pulpwood, excelsior, and slack-cooperage staves.

SOFTWOODS

Eastern softwood timber comprises about 264 billion board feet, or about one-sixth the volume of western softwoods, estimated at 1,616 billion board feet. Nearly three-fourths of the eastern softwood stands are in the South Atlantic and Southern States. Western softwood timber stands of Washington and Oregon contain more than three-fifths of the western softwood timber, those of California about one-fifth, and another one-fifth is scattered along the mountains from Idaho and Montana southward. Many of the western softwood stands are inaccessible because of rough terrain and lack of roads.

The principal localities of growth, characteristics, and uses of woods of the main commercial softwood species or groups of species are described in the following paragraphs.

Baldcypress

Baldcypress (Taxodium distichum) is commonly known as cypress, also as southern cypress, red cypress, yellow cypress, and white cypress. Commercially, the terms "tidewater red cypress," "gulf cypress," "red cypress (coast type)," and "yellow cypress (inland type)" are frequently used.

Cypress grows along the Atlantic Coastal Plain from Delaware to Florida, westward through the Gulf coast region to the Mexican border in Texas, and up the Mississippi Valley to southern Indiana. The heaviest stands are found in the extensive swamps of the lower Mississippi Valley and in Florida. The coastal river swamps of North and South Carolina and of Georgia formerly contained extensive cypress forests. In 1947, about half of the cypress lumber production came from the Southern States and one-fourth from the South Atlantic States.

Sapwood of cypress is narrow and nearly white. The color of the heartwood varies widely, ranging from light yellowish brown to dark brownish red, brown, or chocolate. The wood of cypress is moderately heavy, averaging 32 pounds per cubic foot at 12-percent moisture content. It is moderately strong, moderately hard, and is one of the most durable woods under conditions favorable to decay. Baldcypress has moderately small shrinkage, somewhat greater than that of cedars but less than that of southern pine.

Frequently the wood of certain trees contains pockets or localized areas that have been attacked by a fungus. Such wood is known as "pecky" cypress. The decay caused by this fungus is arrested when the wood is cut into lumber and dried. Pecky cypress therefore is durable and useful where appearance is not important and watertightness is unnecessary.

Cypress is used principally for building construction, especially where resistance to decay is required. It is used for beams, posts, and other members in docks, warehouses, factories, bridges, and heavy construction.

It is well suited for siding and porch construction. It is also used for caskets, burial boxes, sash, doors, blinds, and general millwork, including interior trim and paneling. Other uses are in tanks, vats, ship and boat building, refrigerators, railroad-car construction, greenhouse construction, cooling towers, and stadium seats. It is also used for railway ties, poles, piling, shingles, cooperage, and fence posts.

Douglas-fir

Douglas-fir (*Pseudotsuga taxifolia*) is also known locally as red fir, Douglas spruce, yellow fir, and Oregon pine.

The range of Douglas-fir extends from the Rocky Mountains to the Pacific coast and from Mexico to central British Columbia. In 1947, more than half of Douglas-fir production came from Oregon, nearly 20 percent from Washington, 15 percent from California, and about 6 percent from Idaho and Montana.

Sapwood of Douglas-fir is narrow in old-growth trees but may be as much as 3 inches wide in second-growth trees of commercial size. Growth rings are commonly wider near the center of trees in both old growth and second growth from coast type. Frequently, they average more than one-third of an inch in width for the first 10 years or more. The heaviest wood of Douglas-fir frequently has from 12 to 16 rings per inch. Fairly young trees of moderate to rapid growth have reddish heartwood and are called red fir. Very narrow

ringed wood of old trees may be yellowish brown in color and is known on the market as yellow fir.

The wood of Douglas-fir varies widely in weight and strength. Average material from the Pacific coast is rated as strong, moderately hard, moderately heavy, and very stiff. It averages 34 pounds per cubic foot at 12-percent moisture content. Inland and Rocky Mountain Douglas-fir average somewhat lower in weight than old-growth coast type. Douglas-fir wood splits easily and causes some difficulty because of weakness of bond in growth rings, the cause of which has not been satisfactorily determined. In strength, Pacific coast Douglas-fir is given equal rank with southern yellow pine. The density rule is applied when material of high strength for structural uses is desired. This rule is a method of estimating the density of wood based on percentage of summerwood and rate of growth.

Douglas-fir is used principally for building and construction purposes in the form of lumber, timbers, piling, and plywood. Considerable quantities go into fuel, railway ties, cooperage stock, mine timbers, and fencing. Douglas-fir lumber is used in the manufacture of various products, including sash, doors, general millwork, railroad-car construction, boxes, and crates. Small amounts are used for flooring, furniture, ship and boat construction, wood pipe, and tanks.

Firs, True

The commercial species making up the group of true firs are eight in number: Alpine fir (Abies lasiocarpa), balsam fir (Abies balsamea), California red fir (Abies magnifica), Fraser fir (Abies fraseri), grand fir (Abies grandis), noble fir (Abies procera), Pacific silver fir (Abies amabilis), and white fir Abies concolor).

Two of the species, balsam fir and Fraser fir, grow in the east and the other six in the west. In the United States, balsam fir grows principally in New England, New York, Pennsylvania, and the Lake States. Fraser fir grows in the Appalachian Mountains of Virginia, North Carolina, and Tennessee. White fir grows from the Rocky Mountains to the Pacific coast. Alpine fir grows at high altitudes in the Rocky Mountain region and the Cascade Mountains of Oregon and Washington. Pacific silver fir is limited in distribution to Oregon and Washington. Grand fir is found in western Montana, northern Idaho, northeastern Oregon, and along the coast from Washington to northern California. Noble fir grows in the mountains of northwestern Washington, western Oregon, and northern California. California red fir is limited to the mountains of southwestern Oregon and northern and eastern California.

The wood of balsam fir is creamy white to pale brown in color. Heartwood and sapwood are generally indistinguishable. Because of the similarity of structure, wood of the true firs cannot be separated from an examination of the wood alone. Like balsam fir, the heartwood and sapwood have a similar appearance in all of the species.

Balsam fir averages about 25 pounds per cubic foot at 12-percent moisture content. It is rated as light in weight, weak in bending and compressive strength, moderately limber, soft, and low in resistance to shock. The other true firs are somewhat similar in weight and mechanical properties. White fir averages 26 pounds; grand fir, 28 pounds; Pacific silver fir, 27 pounds; California red fir, 27 pounds; noble fir, 26 pounds; and alpine fir, 23 pounds per cubic foot at 12-percent moisture content. The western firs, except grand fir, have somewhat higher strength properties than balsam fir. Shrinkage of the wood is rated from small to moderately large; noble fir and California red fir have the highest shrinkage. The wood of the true firs lacks durability when subject to conditions favorable to decay.

In the west, the true firs are cut for lumber primarily in Oregon and Washington, which states accounted for about half of the production in 1947. Most of the balance, or about 40 percent, came from California and the remainder from the Rocky Mountain areas. The eastern firs are used principally for pulpwood, although some is cut into lumber, especially in New England and the Lake States. High-grade lumber from noble fir goes principally into interior finish, moldings, siding, and sash and door stock. During World War II, some of the best material was used for aircraft construction. Other special and exacting uses for noble fir are for venetian blinds and ladder rails. Lower-grade lumber is used for boxes. Lumber from white fir and the other western true firs goes principally into building construction, boxes and crates, planing-mill products, sash, doors, and general millwork. In small house construction, lumber of the true firs is used in the form of framing, subflooring, and sheathing. A considerable amount goes into boxes and crates. All of the true firs can be used in the manufacture of various grades of paper.

Hemlock, Eastern

Eastern hemlock (Tsuga canadensis) grows from New England southward along the Appalachian Mountains to northern Alabama and Georgia, and in the Lake States. Other names are Canadian hemlock and hemlock spruce.

In 1947, the production of hemlock lumber was divided fairly evenly between the New England States, the Middle Atlantic States, and the Lake States. North Carolina, South Carolina, and Virginia also produced considerable amounts.

The heartwood of eastern hemlock is pale brown with a reddish hue. Sapwood is not distinctly separated from the heartwood, but may be lighter in color. Growth rings are distinct. The wood is coarse and uneven in texture and inclined to splinter; old trees are subject to ring shake. The wood lacks durability under conditions favorable to decay. It is moderately light in weight, averaging 28 pounds per cubic foot at 12-percent moisture content, moderately hard, moderately weak, moderately limber, and moderately low in shock-resisting ability. It requires care in seasoning. The bark of eastern hemlock contains 10 to 13 percent tannin.

Eastern hemlock is used principally for lumber and paper pulp. The lumber is used largely in building construction for framing, sheathing, subflooring, and roof boards, and in the manufacture of boxes and crates. Pulpwood of eastern hemlock is used principally in the manufacture of newsprint and wrapping paper.

Hemlock, Western

Western hemlock (Tsuga heterophylla) is also known by several other names, including west coast hemlock, hemlock spruce, western hemlock spruce, western hemlock fir, Prince Albert fir, gray fir, silver fir, and Alaska pine.

The heartwood and sapwood of western hemlock are almost white with a purplish tinge. Sapwood, which is sometimes lighter in color, is generally not over 1 inch thick. Growth rings are distinct. The wood contains small, sound, black knots that are usually tight and stay in place. Dark streaks often found in the lumber are caused by hemlock bark maggots.

Western hemlock is moderately light in weight, averaging 29 pounds per cubic foot at 12-percent moisture content. It is moderately hard, moderately weak, moderately stiff, and moderately low in shock resistance. The wood is not highly resistant to decay. It has moderately large shrinkage, about the same as Douglas-fir. Green hemlock lumber contains considerably more water than Douglas-fir, but it is comparatively easy to kiln dry. The bark has a high tannin content, ranging from 12 to 22 percent.

Western hemlock is used principally for pulpwood and lumber. The lumber goes largely into building material, such as sheathing, siding, subflooring, joists, studding, planking, and rafters. Considerable quantities are used in the manufacture of boxes and crates, flooring, and smaller amounts for refrigerators, furniture, and ladders.

Incense-cedar, California

Incense-cedar (Libocedrus decurrens) grows in California, southwestern Oregon, and to a small extent in Nevada. It is generally known as incense-cedar; sometimes simply as cedar. Most of the incense-cedar lumber comes from California and the balance from Oregon.

Sapwood of incense-cedar is white or cream-colored, and the heartwood is light brown, often tinged with red. Growth rings are distinct in wood of comparatively rapid growth. The wood has a fine, uniform texture and a spicy odor. Incense-cedar weighs 25 pounds per cubic foot at 12-percent moisture content. It is moderately weak, soft, low in shock-resisting ability, and lacks stiffness. It has small shrinkage and is easy to season with little checking or warping.

Incense-cedar is used principally for lumber, fence posts, and ties. Nearly all the high-grade lumber is used for making pencils and venetian blinds. The qualities that adapt it to pencil manufacture are straightness of grain, softness, and ease of cutting. Some is used for chests and toys. Much of the incense-cedar lumber is more or less "pecky", that is, contains pockets or areas of disintegrated wood caused by advanced stages of localized decay in the living tree. There is no further development of peck once the lumber is seasoned. This lumber is used locally for rough construction where cheapness and decay resistance are important. Because of its durability,

incense-cedar is well suited for fence posts. It makes satisfactory ties, but requires tie plates on account of the softness of the wood. Other products are poles, grape stakes, and split shingles.

Larch, Western

Western larch (Larix occidentalis) grows in western Montana, northern Idaho, northeastern Oregon, and on the eastern slope of the Cascade Mountains in Washington. It is found at elevations of 2,000 to 7,000 feet. In 1947, about two-thirds of the lumber of this species was produced in Idaho and Montana and one-third in Oregon and Washington.

The heartwood of western larch is yellowish brown and the sapwood, yellowish white. Sapwood is generally not over 1 inch thick. Growth rings are distinct; they are generally quite uniform and range from 15 to 30 per radial inch. The wood is moderately strong, stiff, moderately hard, moderately high in shock-resisting ability, and averages 36 pounds per cubic foot at 12-percent moisture content. It has moderately large shrinkage. The wood is usually straight-grained, splits easily, and is subject to ring shake. It has about the same durability as Douglas-fir. Knots are common but are small and tight. Western larch is rather difficult to season, but if proper drying schedules are used, it can be seasoned satisfactorily. It produces a gum known as galactan, which is useful in the manufacture of baking powders and for several other purposes.

Western larch is used principally in building construction in the form of rough dimension, small timbers, planks, and boards, and for crossties and mine timbers. It is used also for piling, poles, and posts. Some of the high-grade material is manufactured into interior finish, flooring, sash, and doors. Flat-grained flooring subject to heavy wear is likely to separate between the annual rings.

Pine, Eastern White

Eastern white pine (Pinus strobus) grows in the United States from Maine southward along the Appalachian Mountains to northern Georgia and Alabama, and in the Lake States. It is also known as white pine, northern white pine, Weymouth pine, and soft pine.

Lumber production of eastern white pine is confined principally to the New England States, which in 1947 produced about half of the total. About one-third came from the Lake States and most of the remainder from the Middle Atlantic and South Atlantic States.

The heartwood of eastern white pine is light brown, often with a reddish tinge. It turns considerably darker on exposure. Growth rings are distinct. The wood has comparatively uniform texture, and is straight-grained. It is easily kiln dried, has small shrinkage, and ranks high in ability to stay in place. It is also easy to work and can be readily glued.

Eastern white pine is light in weight, averaging 25 pounds per cubic foot. It is moderately soft, moderately weak, and low in resistance to shock. The heartwood is rated as intermediate in decay resistance.

Practically all eastern white pine is converted into lumber, which is put into a great variety of uses. The largest proportion of eastern white pine lumber, which is largely second-growth knotty material of the lower grades, goes into boxes. High-grade lumber goes into patterns for castings. Other important uses are sash, doors, furniture, trim, caskets and burial boxes, shade and map rollers, toys, and dairy and poultry supplies.

Pine, Jack

Jack pine (Pinus banksiana), sometimes known as scrub pine, gray pine, or black pine in the United States, grows naturally in the Lake States and in a few scattered areas in New England and northern New York. In lumber production, jack pine is not separated from the other pines with which it grows, including red pine and eastern white pine.

Sapwood of jack pine is nearly white, and the heartwood is light brown to orange. Sapwood may make up half or more of the volume of a tree. The wood has a rather coarse texture and is somewhat resinous. The wood is moderately light in weight, averaging 30 pounds per cubic foot at 12-percent moisture content. It is moderately weak in bending strength and compressive strength, moderately low in shock resistance, and lacks stiffness. It also has moderately small shrinkage. Lumber from jack pine is generally knotty. Heartwood is rated as intermediate in durability.

Jack pine is used for pulpwood, box lumber, and fuel. Less important uses include railway ties, mine timber, slack cooperage, poles, and posts.

Pine, Lodgepole

Lodgepole pine (Pinus contorta var. latifolia), also known as shore pine, knotty pine, black pine, spruce pine, and jack pine, grows in the Rocky Mountain and Pacific coast regions as far northward as Alaska. In 1947, the cut of lodgepole pine came largely from the South Rocky Mountain States, which produced 88 percent; other producing regions were Idaho, Montana, Oregon, and Washington.

The heartwood of lodgepole pine varies from light yellow to light yellow brown. The sapwood is yellow or nearly white. The wood is generally straight-grained with narrow growth rings.

The wood is moderately light in weight, averaging 29 pounds per cubic foot at 12-percent moisture content. It is fairly easy to work. It has moderately large shrinkage. In strength properties, lodgepole pine rates as moderately weak, moderately stiff, moderately soft, and moderately low in shock resistance. It is not considered durable under conditions favorable to decay.

Lodgepole pine is used for lumber, mine timbers, railway ties, and poles. It is gaining some importance for pulpwood. Less important uses include posts and fuel. Lumber is used mostly for local rough construction and for boxes. It is being used in increasing amounts for siding, finish, and flooring, especially where other species are not readily available.

Pine, Ponderosa

Ponderosa pine (Pinus ponderosa) is known also as pondosa pine, western soft pine, western pine, California white pine, bull pine, and black jack. Jeffrey pine (Pinus jeffreyi), which grows in close association with ponderosa pine in California and Oregon, is usually marketed with ponderosa pine and sold under that name.

Ponderosa pine grows to some extent in every state west of the Great Plains, also in British Columbia and northern Mexico. Major producing areas are in Oregon, Washington, California, and Nevada. Other important producing regions are in Idaho and Montana; lesser amounts come from the states of the South Rocky Mountain region.

Botanically, ponderosa pine belongs to the yellow pine group rather than the white pine group. A considerable proportion of the wood, however, is somewhat similar to the white pines in appearance and properties. Heartwood is light reddish brown, and the wide sapwood is nearly white to pale yellow. Growth rings are generally distinct when not exceedingly narrow.

The wood of the outer portions of ponderosa pine of saw-timber size is generally moderately light in weight, averaging 28 pounds per cubic foot at 12-percent moisture content. It is moderately weak, moderately stiff, moderately soft, and moderately low in shock resistance. It is generally straight-grained and has moderately small shrinkage. It is quite uniform in texture and has little tendency to warp and twist. Wood in young trees and in the heartwood of older trees is sometimes heavier, harder, and stronger than in the outer portion of the older trees. Wood of ponderosa pine grown on the east side of the Sierra Nevada Mountains is reported to be comparatively soft and uniform in texture, while that grown on the west side of the mountains, a region of greater rainfall, is harder and less uniform in texture.

Ponderosa pine is used principally for lumber and to a lesser extent for piling, poles, posts, mining timbers, veneer, and hewed ties. Low-grade material is widely used for fuel. The clear softer wood goes into sash, doors, blinds, moldings, paneling, mantels, trim, and built-in cases and cabinets. Lower-grade lumber is used for boxes and crates. Much of the lumber of intermediate or lower grades goes into sheathing, subflooring, roof boards, floor joists, studs, and rafters. Knotty ponderosa pine is used for interior finish.

Pine, Red

Red pine (Pinus resinosa) is frequently called Norway pine. This name comes from the town of Norway, Maine, and not from the European country. It is occasionally known as hard pine and pitch pine. Red pine grows in the

New England States, New York, Pennsylvania, and the Lake States. In the past, lumber from red pine has been marketed with white pine without distinction as to species.

The heartwood of red pine varies in color from pale red to a reddish brown. The sapwood is nearly white with a yellowish tinge and is generally from 2 to 4 inches wide. The wood resembles the lighter-weight wood of southern yellow pine. Summerwood is distinct in the growth rings.

Red pine is moderately heavy, averaging 34 pounds per cubic foot at 12-percent moisture content. It is moderately strong and stiff, moderately soft, and moderately high in shock resistance. It is generally straight-grained, not so uniform in texture as eastern white pine, and somewhat resinous. The wood has moderately large shrinkage, but is not difficult to dry and stays in place well when seasoned. It is not durable under conditions favorable to decay.

Red pine is used principally for lumber and to a lesser extent for piling, poles, cabin logs, hewed ties, posts, and fuel. The wood is used for many of the same purposes as eastern white pine. It goes principally into building construction, siding, piling, flooring, sash, doors, blinds, general millwork, and boxes and crates.

Pine, Southern Yellow

There are a number of species included in the group known as southern yellow pine. They are:

(1) Longleaf pine (Pinus palustris), which grows from eastern North Carolina, south into Florida, and westward through Alabama, Mississippi, and Louisiana into eastern Texas.

(2) Shortleaf pine (Pinus echinata), which grows from southeastern New York and New Jersey southward to northern Florida and westward into eastern Texas and Oklahoma. Northern limits of growth are the Ohio Valley and southern Missouri.

(3) Loblolly pine (Pinus taeda), which grows from Maryland southward through the Atlantic Coastal Plain and Piedmont Plateau into Florida and westward into eastern Texas. The northern limit of growth west of the Appalachian Mountains is near the southern Tennessee border.

(4) Slash pine (Pinus caribaea), which grows in Florida and the southern parts of South Carolina, Georgia, Alabama, Mississippi and Louisiana east of the Mississippi River.

Other southern yellow pines of less commercial importance include Virginia pine (Pinus virginiana), pond pine (Pinus rigida serotina), and spruce pine (Pinus glabra).

Many names are applied to the various species of southern yellow pine. Longleaf is known also as pitch pine in export trade and as Georgia pine,

Florida pine, Texas yellow pine, and hard pine. Slash pine may be called Cuban pine, yellow slash pine, swamp pine, and pitch pine. Shortleaf pine may be called yellow pine, Arkansas shortleaf pine, North Carolina pine, and Rosemary pine. Loblolly pine is known as oldfield pine, North Carolina pine, sap pine, and shortleaf pine.

The southern yellow pine lumber comes principally from the Southern and South Atlantic States. The states leading in production in 1947 were Georgia, Alabama, North Carolina, and Texas in the order named, each producing over a billion board feet.

The wood of the various southern yellow pines is quite similar in appearance. The sapwood is yellowish white, and the heartwood is reddish brown. Growth rings in the southern yellow pines are usually prominent, each made up of a band of dark-colored summerwood and a band of light-colored springwood. Width of the annual rings varies greatly, depending upon the conditions under which the trees have grown. Rings may be as much as 1 inch in width in young trees in old-field stands or extremely narrow in the outer part of old-growth trees. The sapwood is usually white in second-growth stands. Heartwood begins to form when the tree is about 20 years old. In old, slow-growth trees, sapwood may be only 1 or 2 inches in width. The wood of any species of southern yellow pine may vary widely with changing conditions of growth in a stand, so that lightweight wide-ringed wood and comparatively heavy close-ringed wood may exist in the same tree.

Longleaf and slash pines are classed as heavy and strong, slash pine averaging 43 pounds and longleaf pine, 41 pounds per cubic foot at 12-percent moisture content. Slash pine from southern Florida is typically more dense than that from nearer the northern limits of its range, particularly second growth. Longleaf and slash pine are classed as stiff, hard, and moderately high in shock resistance. Shortleaf and loblolly pines are somewhat lighter in weight than longleaf, averaging 36 pounds per cubic foot at 12-percent moisture content. Under certain conditions of growth, however, shortleaf and loblolly will produce wood equal in weight to that of longleaf and slash. The other species of southern yellow pine have properties similar to shortleaf and loblolly pine. In order to obtain heavy, strong wood of the southern yellow pines for structural purposes, a "density rule" has been written which specifies certain visual characteristics for structural timbers.

Heartwood of the southern yellow pines is intermediate in durability. Sapwood is lacking in durability but can be readily treated with preservatives. Southern yellow pine lumber can be satisfactorily seasoned either by air drying or by kiln drying. All the southern yellow pines have moderately large shrinkage but stay in place well when properly seasoned.

Dense southern yellow pine is used extensively in construction of factories, warehouses, bridges, trestles, and docks in the form of stringers, beams, posts, joists, and piling. Lumber of lower density and strength finds many uses for building material, such as interior finish, weatherboarding, sheathing, subflooring, and joists, and for boxes and crates. Southern yellow pines are used also for slack cooperage. When used for railway ties, telephone and telegraph poles, and mine timbers, southern yellow pine is treated with preservatives.

Longleaf pine and slash pine are the source of turpentine and rosin, known as naval stores. Wood turpentine, tar, and oils may be obtained also by distillation of southern yellow pine wood, especially heartwood, which is rich in resin. Considerable quantities of southern yellow pine are used in making wrapping paper and pulp board.

Pine, Sugar

Sugar pine (Pinus lambertiana) is sometimes called California sugar pine. The range of sugar pine extends from the Coast and Cascade Mountain Ranges of southern Oregon along the Coast Ranges and the Sierra Nevada mountains of California through southern California and into lower California in Mexico. Most of the sugar pine lumber is produced in California and the remainder in southwestern Oregon.

The heartwood of sugar pine is buff or light brown, sometimes tinged with red. Sapwood is creamy white. The wood frequently becomes discolored during the seasoning process because of the action of blue or brown stain fungi. These stains do not affect the strength properties of the wood but do affect its appearance and suitability for natural finishes. Sugar pine contains resin canals, which show on cross sections or tangential faces as small, dark-colored dots or as thin, dark-colored streaks. The wood is straight-grained, fairly uniform in texture, and easy to work with tools. It has very small shrinkage, is readily seasoned without warping of checking, and stays in place well. Sugar pine is light in weight, averaging 25 pounds per cubic foot at 12-percent moisture content. It is moderately weak, moderately soft, low in ability to resist shock and lacks stiffness. It is rated intermediate in ability to resist decay.

Sugar pine is used almost entirely in the form of lumber or products manufactured from lumber. The largest amounts are used in building construction, boxes and crates, sash, doors, frames, blinds, general millwork, and foundry patterns. Like eastern white pine, sugar pine is suitable for use in nearly every part of a house because of the ease with which it can be cut, its ability to stay in place, and its good nailing properties. It is coming into increasing use as pattern wood in foundries. It is readily available in wide, thick pieces, practically free from defects.

Pine, Western White

Western white pine (Pinus monticola) is also known as Idaho white pine or white pine. In the United States, it grows in western Montana, northern Idaho, and along the Cascade and Sierra Nevada Mountains through Washington and Oregon to central California.

In 1947, about four-fifths of the cut came from Idaho with a considerable amount from Washington; small amounts were cut in Montana and Oregon.

Heartwood of western white pine is cream-colored to light reddish brown and darkens on exposure. The sapwood is yellowish white and generally from 1

to 3 inches wide. The wood is straight-grained, easy to work, easily kiln-dried, and stays in place well after seasoning.

Western white pine is moderately light in weight, averaging 27 pounds per cubic foot at 12-percent moisture content. It is moderately weak, moderately stiff, moderately soft, moderately low in shock resistance, and has moderately large shrinkage. Heartwood is rated as intermediate in decay resistance.

Practically all western white pine is sawed into lumber and used principally for building construction, matches, boxes, and millwork products, such as sash, frames, doors, and blinds. In building construction, boards of the lower grades are used for sheathing, subflooring, and roof strips. High-grade material is made into siding of various kinds, exterior and interior trim, partitions, casings, bases, and paneling. It has practically the same uses as eastern white pine and sugar pine. A large proportion of western white pine is used in the manufacture of matches.

Redcedar, Eastern

Eastern redcedar (Juniperus virginiana) grows throughout the eastern half of the United States, except Maine, Florida, and a narrow strip along the Gulf Coast and at the higher elevations in the Appalachian Mountain Range. Another species, southern redcedar (Juniperus silicicola), grows over a limited area in the South Atlantic and Gulf Coastal Plains.

Commercial production of eastern redcedar is now becoming restricted to rather small areas in Tennessee and Kentucky.

The heartwood of redcedar is bright red or dull red, and the thin sapwood is nearly white. The wood is moderately heavy, averaging 33 pounds per cubic foot at 12-percent moisture content. It is moderately weak, hard, high in shock resistance, but lacks stiffness. It has very small shrinkage and stays in place well after seasoning. The texture is fine and uniform. Grain is usually straight, except where deflected by knots, which are numerous. Eastern redcedar is very resistant to decay.

The greatest quantity of eastern redcedar is used for fence posts. Lumber is manufactured into chests, wardrobes, and closet lining. Other uses include flooring, pencils, scientific instruments, and small boats. Southern redcedar is used for the same purposes as eastern redcedar.

Redcedar, Western

Western redcedar (Thuja plicata) grows in northern California, western Oregon, western and northeastern Washington, northern Idaho, and northwestern Montana. It grows also along the Pacific coast northward to Alaska. Western redcedar is also called canoe cedar, giant arborvitae, shinglewood, and Pacific redcedar. Western redcedar lumber is produced principally in Washington, followed by Oregon, Idaho, and Montana.

The heartwood of western redcedar is reddish brown in color, and the sapwood is nearly white. Sapwood is narrow, often not over 1 inch in width. The wood is generally straight-grained and has a uniform but rather coarse texture. It has very small shrinkage. Western redcedar is light in weight, averaging 23 pounds per cubic foot at 12-percent moisture content. It is moderately soft, weak when used as a beam or post, and low in shock-resisting ability. It is one of the most durable native woods. It requires care in kiln drying but stays in place well if properly seasoned.

Western redcedar is used principally for shingles, lumber, poles, posts, and piling. The lumber is used for exterior siding, interior finish, greenhouse construction, ship and boat building, boxes and crates, sash, doors, and millwork.

Redwood

Redwood (Sequoia sempervirens) is a very large tree growing on the coast of California. Another sequoia (Sequoia gigantea) grows in the Sierra Nevada Mountains of California. Other names for redwood are coast redwood, California redwood, Humbolt redwood, and sequoia. Production of redwood lumber is limited to California.

The heartwood of redwood varies in color from a light cherry to a dark mahogany. The narrow sapwood is almost white. Typical old-growth redwood is moderately light in weight, averaging 30 pounds per cubic foot at 12-percent moisture content. It is moderately strong, moderately stiff, and moderately hard. The heaviest redwood generally has 9 to 30 growth rings per radial inch. The wood is easy to work, generally straight-grained, and shrinks and swells comparatively little. The heartwood has high durability under conditions favorable to decay. Second-growth trees are likely to have much wider growth rings, particularly toward the center of the trees, and to contain wood somewhat lower in density and related strength properties than old-growth trees.

Most of the production of redwood is used in the form of lumber for planks, dimension, boards, joists, beams, stringers, and posts in the construction of buildings, bridges, and trestles. It is also remanufactured into shipping containers, siding, ceiling and finish, sash, doors, blinds, and millwork. Because of its durability, it is useful for cooling towers, tanks, silos, caskets, wood-stave pipe, and outdoor furniture.

Spruce, Engelmann

Engelmann spruce (Picea engelmanni) grows at high elevations in the mountain regions of the western part of the United States and Canada. Engelmann spruce is sometimes known by other names, such as white spruce, mountain spruce, Arizona spruce, silver spruce, and balsam.

About two-thirds of the production of Englemann spruce lumber is in the South Rocky Mountain States. Most of the remainder comes from the North Rocky Mountain States and Oregon.

The heartwood of Engelmann spruce is nearly white in color with a slight tinge of red. The sapwood varies from 3/4 to 2 inches in width and is often difficult to distinguish from heartwood. The wood has medium to fine texture and is without characteristic taste or odor. It is generally straight-grained. Engelmann spruce is rated as light in weight, averaging 23 pounds per cubic foot at 12-percent moisture content. It is weak when used as a beam or post. It is limber, soft, low in ability to resist shock, and has moderately small shrinkage. The lumber contains small knots.

Engelmann spruce is used principally for lumber and in limited amounts for mine timbers, railway ties, and poles. It is used also in building construction in the form of dimension stock, flooring, sheathing, and studding. It is finding use in the pulp industry because of its excellent pulp- and paper-making properties.

Spruce, Sitka

Sitka spruce (Picea sitchensis) is a tree of large size growing along the northwestern coast of North America from California to Alaska. It is generally known as Sitka spruce, although other names may be applied locally, such as yellow spruce, tideland spruce, western spruce, silver spruce, and west coast spruce.

About two-thirds of the production of Sitka spruce lumber comes from Washington, and one-third from Oregon. Small amounts are produced in California.

The heartwood of Sitka spruce is a light pinkish brown. Sapwood is creamy white and shades gradually into the heartwood. Sapwood may be 3 to 6 inches wide or even thicker in young trees. The wood has a comparatively fine, uniform texture, generally straight grain, and no distinct taste or odor. It is moderately light in weight, averaging 28 pounds per cubic foot at 12-percent moisture content. It is moderately weak in bending and compressive strength, moderately stiff, moderately soft, moderately low in resistance to shock, and has moderately small shrinkage. On the basis of weight, it rates high in strength properties and can be obtained in clear, straight-grained pieces of large size.

Sitka spruce is used principally for lumber, paper pulp, and cooperage. Boxes and crates consume about half of the remanufactured lumber. Other important uses are furniture, planing-mill products, sash, doors, blinds, millwork, cooperage, and boats.

Sitka spruce has been by far the most important wood for aircraft construction. Other specialty uses are ladder rails and sounding boards for pianos.

White-cedar

There are two species of white-cedar in the eastern part of the United States. They are northern white-cedar (Thuja occidentalis) and Atlantic white-cedar (Chamaecyparis thyoides). Northern white-cedar is also known as

arborvitae, or simply cedar. Atlantic white-cedar is also known as juniper, southern white-cedar, swamp cedar, and boat cedar.

Northern white-cedar grows from Maine southward along the Appalachian Mountain Range to northern Georgia and westward through the northern part of the Lake States. It also grows in the southeastern part of Canada. Atlantic white-cedar grows near the Atlantic coast from Maine to northern Florida and westward along the Gulf coast to Louisiana. It is strictly a swamp tree.

Production of northern white-cedar lumber is probably greatest in Maine and the Lake States. Census reports do not separate production of northern white-cedar from that of other eastern cedars. Commercial production of Atlantic white-cedar centers around eastern North Carolina and along the Gulf coast.

Heartwood of the white-cedars is light brown, and the sapwood is white or nearly so. Sapwood is usually thin. The wood is light in weight, northern white-cedar averaging 22 pounds and Atlantic white-cedar, 23 pounds per cubic foot at 12-percent moisture content. The wood is rather soft and weak and is low in shock-resisting ability. It shrinks little in drying. The wood is easily worked, holds paint well, and is highly resistant to decay. The two species are used for similar purposes, principally for poles, ties, lumber and posts. White-cedar lumber is used principally where high degree of durability is needed as in tanks and boats, and for woodenware.

White-cedar, Port Orford

Port Orford white-cedar (Chamaecyparis lawsoniana) is commonly called Port Orford cedar. It is sometimes known as Lawson's cypress, Oregon cedar, and white-cedar. It grows along the Pacific coast from Coos Bay, Oregon, southward to the Mad River in Humboldt County, California. It does not extend more than 40 miles inland or more than 5,000 feet in elevation on the westward slopes of the Coast Range.

The heartwood of Port Orford white-cedar is light yellow to pale brown in color. Sapwood is thin and hard to distinguish. The wood has fine texture, generally straight grain, and a pleasant spicy odor. It is moderately light in weight, averaging 29 pounds per cubic foot at 12-percent moisture content. It is stiff, moderately strong, moderately hard, and moderately resistant to shock. Port Orford white-cedar is one of the most durable woods. The wood shrinks moderately, has little tendency to warp and stays in place well after seasoning.

A large proportion of the high-grade Port Orford white-cedar is used in the manufacture of battery separators and venetian-blind slats. Other uses are "mothproof" boxes, sash and door construction, flooring, interior finish, furniture, and boat building.

Yellow-cedar, Alaska

Alaska cedar (Chamaecyparis nootkatensis) grows in the Pacific coast region of North America from southeastern Alaska southward through Washington to southern Oregon. In Washington and Oregon, it is confined to the west side of the Cascade Mountains, usually above an elevation of 2,000 feet. It reaches its best development along the coast and on the nearby islands of southern Alaska and British Columbia.

The heartwood of Alaska cedar is bright, clear yellow. The sapwood is narrow, white to yellowish, and hardly distinguishable from the heartwood. Growth rings are not easily visible. The wood is fine-textured and generally straight-grained. It is moderately heavy, averaging 31 pounds per cubic foot at 12-percent moisture content. It is moderately strong, moderately stiff, moderately hard, and moderately high in resistance to shock. Alaska cedar shrinks little in drying, stays in place well after seasoning, and is very resistant to decay. The wood has a mild, unpleasant odor.

Alaska cedar is used locally for interior finish, furniture, small boats, cabinet work, and novelties.

Table 1.--Forest land area of the United States by class of forest, character of growth, and by state and region.

(Thousand acres)

State and region	Total forest land	Commercial forest[1]					Reserved for parks[2]	Noncommercial forest[6]
		Total	Old-growth saw-timber[2]	Young-growth saw-timber[2]	Re-stocking[3]	Poorly stocked and denuded[4]		
New England								
Connecticut	1,907	1,900	-	403	1,264	233	7	-
Maine	16,788	16,664	150	9,189	5,905	1,421	103	21
Massachusetts	3,310	3,297	2	936	1,842	523	12	1
New Hampshire[7]	4,848	4,682	-	1,808	2,248	626	25	141
Rhode Island	452	447	-	28	555	64	5	-
Vermont	3,835	3,820	16	1,588	1,745	471	-	15
Total	31,140	30,811	168	13,946	13,359	3,338	152	177
Middle Atlantic								
Delaware	442	442	2	200	195	45	-	-
Maryland	2,742	2,722	4	848	1,495	375	18	2
New Jersey	2,348	2,329	2	423	1,494	410	17	2
New York	13,500	11,114	49	5,527	4,238	1,500	2,545	2,386
Pennsylvania	15,228	15,127	20	3,725	8,100	3,282	80	101
West Virginia	9,954	9,852	84	4,129	5,392	247	-	102
Total	44,214	41,586	161	14,852	20,914	5,859	2,489	2,628
Lake								
Michigan	19,000	17,380	1,125	1,645	10,810	3,800	512	1,068
Minnesota	17,700	16,700	260	1,540	10,100	5,000	400	1,000
Wisconsin	17,000	16,265	125	1,975	9,075	5,090	80	735
Total	53,700	50,345	1,510	4,960	29,985	13,890	1,192	3,355
Central								
Illinois[7]	5,996	5,941	-	1,824	1,712	405	55	-
Indiana	3,445	3,358	-	1,448	1,480	424	87	-
Iowa	2,248	2,226	-	1,168	734	324	22	-
Kansas	1,121	1,011	100	350	450	111	10	110
Kentucky	11,867	11,694	145	4,075	5,900	1,576	84	89
Missouri[7]	15,888	15,074	-	2,034	11,263	1,777	114	700
Nebraska	1,112	987	75	246	486	180	25	100
North Dakota	681	411	-	110	220	140	15	156
Ohio	4,831	4,779	-	2,079	1,892	808	52	-
Total	44,419	43,540	320	13,332	24,143	5,745	460	419
South Atlantic								
North Carolina	18,400	17,797	-	5,588	6,584	1,825	332	71
South Carolina[7]	11,943	11,900	-	5,042	5,969	889	40	3
Virginia	14,832	14,577	-	7,138	6,462	777	271	184
Total	45,175	44,274	-	21,768	19,015	3,491	643	258
South								
Alabama	18,878	18,800	80	10,071	5,167	3,482	61	17
Arkansas	20,036	19,928	180	12,647	5,004	2,097	16	92
Florida[7]	23,047	21,451	-	3,233	5,826	12,392	46	1,550
Georgia	21,432	21,107	150	11,252	5,300	4,405	227	98
Louisiana	16,1[illegible]	16,169	189	9,852	2,902	3,226	10	17
Mississippi[7]	16,533	16,509	-	9,945	8,664	1,900	24	-
Oklahoma	10,646	4,308	25	2,034	1,127	1,122	7	6,331
Tennessee	12,165	11,850	-	6,566	4,513	771	254	61
Texas	36,5[illegible]	14,788	143	6,966	2,091	1,588	8	25,767
Total	175,486	140,910	767	68,566	40,594	30,983	653	33,923
Total East	353,134	351,466	2,926	137,224	148,010	63,506	5,535	33,133
Pacific Northwest								
Douglas-fir subregion	29,145	26,027	9,348	3,810	7,434	5,435	1,032	2,086
Pine subregion	24,71[illegible]	20,177	9,171	3,969	6,222	815	472	4,061
Total	53,8[illegible]	46,204	18,519	7,779	13,656	6,250	1,504	6,147
Oregon	29,755	26,330	11,904	4,810	6,469	3,147	448	2,977
Washington	24,100	19,874	6,615	2,969	7,187	3,103	1,056	3,171
Total	53,855	46,204	18,519	7,779	13,656	6,250	1,504	6,147
California	45,515	16,405	8,400	2,497	3,451	2,057	705	28,405
North Rocky Mountain								
Idaho	18,813	10,149	2,236	2,530	4,333	1,050	269	8,395
Montana	24,238	14,758	3,445	1,503	9,327	483	673	8,807
Total	43,051	24,907	5,681	4,033	13,660	1,533	942	17,202
South Rocky Mountain								
Arizona	19,538	2,815	1,769	600	221	25	332	16,391
Colorado	19,902	7,874	2,324	1,052	3,584	914	800	11,228
Nevada	4,720	98	31	9	58	-	-	4,622
New Mexico	20,001	3,465	1,834	560	872	199	710	15,826
South Dakota	1,979	1,765	592	388	770	215	65	149
Utah	8,494	1,530	987	251	276	16	41	6,923
Wyoming	8,878	3,012	1,244	404	1,317	47	1,869	3,997
Total	83,512	20,559	8,781	3,064	7,098	1,616	3,817	59,136
Total West	225,933	108,075	41,381	17,373	37,865	11,456	6,968	110,889
Total United States	622,067	459,541	44,307	154,597	185,875	74,762	12,503	150,022

[1] Land capable of producing timber of commercial quantity and quality, and available now or prospectively for commercial use.

[2] Includes areas characterized by timber large enough for sawlogs (lumber) and in sufficient volume per acre for economic operation.

[3] Includes areas characterized by timber of cordwood size (5 inches diameter breast high and larger) but too small for sawlogs, and seedling and sapling areas on which at least 40 percent of the growing space is occupied by commercial species predominantly below pole timber size and below minimum volume per acre for sawtimber or for pole timber.

[4] Includes lands that do not qualify in any previous class.

[5] Commercially valuable land in parks, preserves, and other holdings withdrawn from timber use.

[6] Land chiefly valuable for purposes other than timber production such as watershed protection, reducing soil erosion, and protecting wild life.

[7] Data from the Forest Survey, 1946-1949.

Source: Forest Service, U. S. Department of Agriculture. Estimates as of January 1, 1945 from a Reappraisal of the Forest Situation, except as noted in footnote[7].

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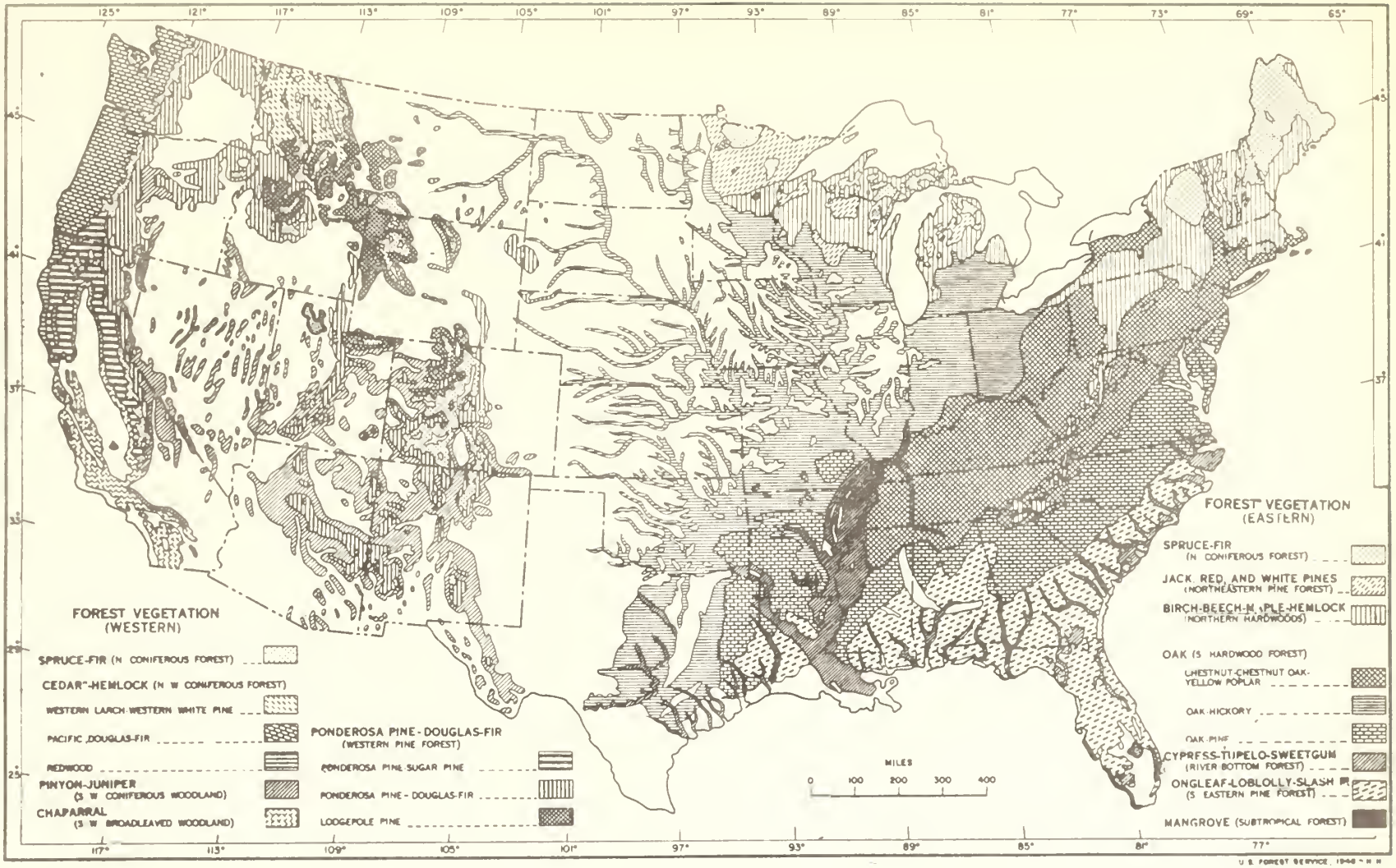
Figure 1.--Forest vegatation of the United States (adapted from Shantz and Zon's "Natural Vegetation" map of the United States in the "Atlas of American Agriculture").


FOREST VEGETATION (WESTERN)
SPRUCE-FIR (N CONIFEROUS FOREST)
CEDAR-HEMLOCK (N W CONIFEROUS FOREST)
WESTERN LARCH-WESTERN WHITE PINE
PACIFIC DOUGLAS-FIR
REDWOOD
PINYON-JUNIPER (S W CONIFEROUS WOODLAND)
CHAPARRAL (S W BROADLEAVED WOODLAND)
PONDEROSA PINE-DOUGLAS-FIR (WESTERN PINE FOREST)
PONDEROSA PINE-SUGAR PINE
PONDEROSA PINE-DOUGLAS-FIR
LODGEPOLE PINE
MILES
0 100 200 300 400
FOREST VEGETATION (EASTERN)
SPRUCE-FIR (N CONIFEROUS FOREST)
JACK, RED, AND WHITE PINES (NORTHEASTERN PINE FOREST)
BIRCH-BEECH-MAPLE-HEMLOCK (NORTHERN HARDWOODS)
OAK (S HARDWOOD FOREST)
CHESTNUT-CHESTNUT OAK-YELLOW POPLAR
OAK-HICKORY
OAK-PINE
CYPRESS-TUPELO-SWEETGUM (RIVER BOTTOM FOREST)
ONGLEAF-LOBLOLLY-SLASH PINE (S EASTERN PINE FOREST)
MANGROVE (SUBTROPICAL FOREST)
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